cycles

—A MONTHLY REPORT

December 1953

FOUNDATION FOR THE STUDY OF CYCLES

New York, New York

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The Director's Letter

Dear Member:

You of course remember the story of the two stone masons. When asked what he was doing the first said, "I am surfacing a piece of stone." but the second, doing exactly the same sort of work, replied, "I am helping to build a cathedral."

Maybe so, but I'll venture that when he went home at night the second mason did not say anything to his wife about the cathedral. Instead he likely said, "I got a bit of stone in my eye today." At best he may have said, "Well, today I finished dressing the trim for the south window."

So it is with our monthly reports. We *are* helping to build a cathedral—several of them in fact—and occasionally we remember this, but mostly we are concerned with the trim of a south window or the slivers of stone we get in our eyes—the 5.91-year cycle in cotton prices for example, or the member who has neglected to pay his dues.

Well, let us take a look at some of the cathedrals.

Cathedral Number One—The Advancement of Human Knowledge. We are doing our part toward learning how the universe ticks. We are opening up a huge new segment of knowledge. We are discovering evidence of hitherto unsuspected forces.

Of course I do not flatter myself that knowing all this will help very much. As Clarence Day put it in *This Simian World,* "And we, who crave so much to know, crave so little but knowing. Some of us wish to know Nature most; those are the scientists. Others, the saints and philosophers, wish to know God. Both are alike in their hearts, yes, in spite of their quarrels. Both seek to assuage, to no end, the old simian thirst.

"If we wanted to *be* Gods--but ah, can we grasp that ambition?"

Knowing *all* about cycles—knowing all about everything—won't help very much, but it might help a little.

Cathedral Number Two—The Elimination of War. There is *no* hope of eliminating war for yourself or your children or your grandchildren. As Oswald Spengler said, for us it is not a matter of war or peace; it is a matter of victory or slavery.

But—hopefully—you will have great-great (etc.) grandchildren. It is for them we are building.

Wars are cyclic. That is, the number of international battles tends to pulsate at reasonably regular time intervals. Wars act as if they were stimulated by regularly recurring cyclic forces.

These forces are presumably external to human life, for when the rhythm of war is disturbed, it returns to the old pattern. And the rhythms are the same as we find in animal life and other aspects of nature.

As part of the problem of eliminating war we must understand these rhythmic forces and how they operate. The extent to which wars conform to these rhythmic,

forces shows that rhythms are a very large part of the matter indeed.

In the meantime it is handy to have foreknowledge of when the next maximum number of international battles can most probably be expected.

Cathedral Number Three. The Elimination of Depressions. Only by understanding the forces that cause depressions can we ever learn to control them. There is a growing mass of evidence that depressions recur at rhythmic time intervals. All the various aspects of depression—curtailed production, business failures, unemployment, financial collapse—insofar as they have been studied, act as if they have been influenced by rhythmic forces, the nature of which is as yet unknown. Until we know what these forces are and how they operate, which are significant and which are merely accidental, which are physical or biological, and which are economic, any true science of economics is impossible. A fairly complete knowledge of cycles would seem to be indispensable to the understanding and elimination of depressions.

In the meantime, while we are learning how to control depressions and before we attain this goal, a knowledge of cycles can be used to throw light on probable future economic oscillation.

Cathedral Number Four. The Elimination of Disease. Cycles are probably not very important in disease elimination, but a knowledge of them should help some.

Cathedral Number Five. Accurate Weather Forecasting A Year or More in Advance. How wonderful it will be, in the future, for the farmers to know the years when we are going to have late frosts—or droughts --or unseasonable autumns. What heartache and uneconomic use of seed and time will be avoided. How wonderful for our military commanders when they too can be sure of the weather, as far into the future as they may need the information. Our foresters will rejoice in such foreknowledge. So will our mariners, our hydroelectric companies, our flood control experts—even our football and our baseball fans.

Other "cathedrals" could be named, for there are 36 different aspects of science where a knowledge of cycles is important. But perhaps I have listed enough cathedrals for one day. Probably I had better now get back to stone cutting. Cathedrals do not get built by talking about them.

This Month's Supplement

In this issue I am reprinting for you the historic paper by Kondratieff in which he tells about his discovery of long cycles in various aspects of economic life. The cycles he observed are 50 to 60 years long. They seem to be the same as the 54-year cycle in British wheat prices discovered a few years earlier by Sir William Beveridge.

More refined measurements on longer series of figures than those available to Kondratieff suggest that the current trough in production was due ideally about 1933; in prices (in gold) it was due ideally about 1952.

In production the trough came about on time. This cycle is seemingly responsible for part of the tremendous upsurge in production we have had since that time.

In prices (in gold) the trough came 9 or 10 years early, perhaps in part as a distortion due to World War II. It is seemingly responsible for part of our present high prices.

Peaks of this cycle in production are due about 1960; in prices (in gold) about 1978. But remember that this observation refers only to the broad picture. Year by year variations are governed by shorter cycles (and of course random factors) which must also be taken into account before a forecast can be made.

For theoretical reasons the long cycles are important because they do not seem to come so close to each other in wave length as the shorter cycles. This fact—if it is a fact—may help us someday to determine the cause of cycles.

Cordially yours,

Edward R. Dewey

Director

Research

CYCLES IN MANUFACTURING PRODUCTION —continued

You will remember that I am studying the index of manufacturing production to see what rhythmic cycles may be present. Rhythmic cycles which have repeated so often and so regularly that they cannot reasonably be the result of chance must be taken into account as probabilities for the future. In this way we may throw some light on the time, severity, and extent of the next depression.

In our November report I isolated the 54-year cycle and the 11.2-year cycle. Of course, in a series of figures so short, any study of the 54-year cycle is fancy guessing. But the 11.2-year cycle would seem to stand on fairly firm ground.

In this report I discuss a cycle 13.0 years long and one 9.3 years long.

It may not be amiss at this point to show (in Fig. 1) the present positions of the four cycles isolated to date. I have refrained from combining them, lest you be misled as to the future. Additional cycles should be isolated and projected before we can venture a cycle projection. This work will be carried forward in our January report.

E.R.D.

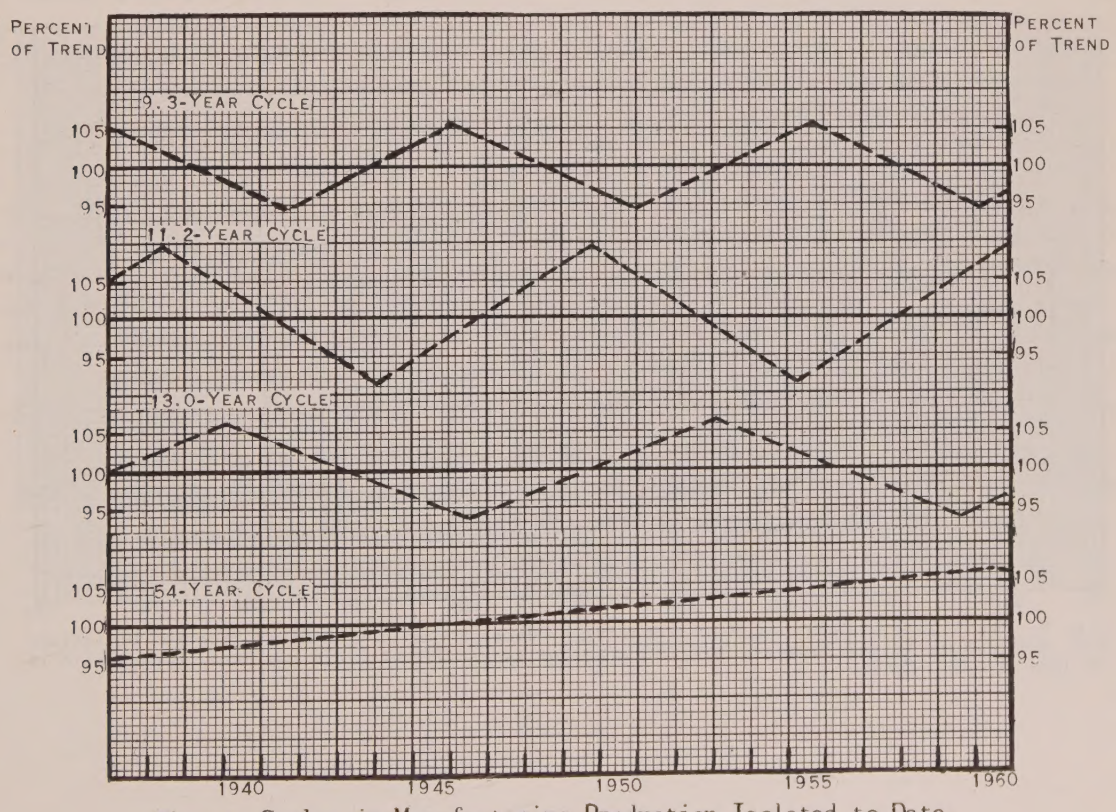


Fig. 1. Cycles in Manufacturing Production Isolated to Date.

Part IV—The 9.3–Year Cycle

Summary: A rhythmic 9.3-year cycle has been present in manufacturing production for as far back as there are figures. It seems to be significant. It has an overall amplitude or strength of 11.5% of trend. It has been in upward phase since 1951 and is due to crest in 1955, trough in 1960. It partly offsets the effect of the 11.2-year cycle, due to trough in 1955 (in contrast to 1933 when the two cycles troughed together).

IT does not seem necessary to reprint in this issue the chart of the index of manufacturing production which I printed for you in our November report.

I am, however, printing a chart of these figures smoothed, but with trend, war distortions, and the 11.2-year cycle removed, so that you can see the 9.3-year cycle more clearly (Fig. 2). It is obvious that many other factors, either random or rhythmic or both, are also present. Nevertheless a rhythm of about 9.3 years shows through clearly. To aid your eye it has been diagrammed by a broken zig-zag line.

Crests of the ideal cycle come at 1862.65 and every 9.3 years thereafter. Troughs come ideally 4.65 years after crests. The current trough was due ideally at 1951. The next crest is due ideally at 1955. Remember, however, that other cycles and random factors pull the actual tops and bottoms one way or the other, sometimes by as much as several years.

The typical strength of the cycle is from 5.9% above trend at ideal crest to 5.6% below trend at ideal trough.

E.R.D.

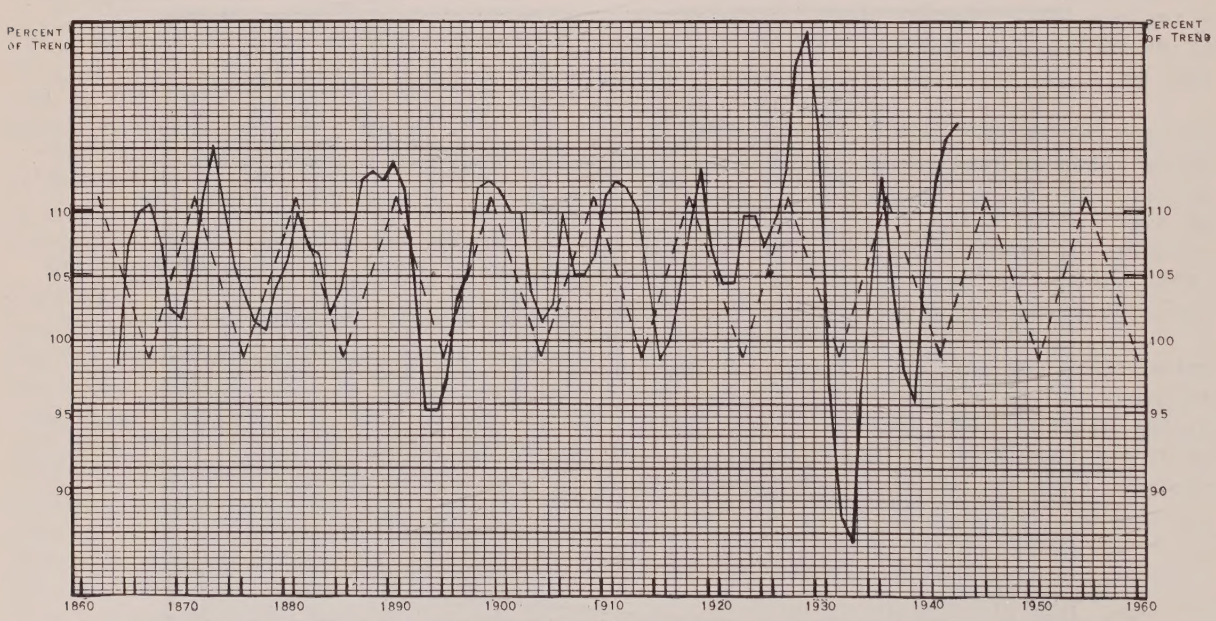


Fig. 2. The 9.3-Year Cycle in Manufacturing Production. Solid Line Shows Smoothed Deviations from the 11-Year Moving Average, Both Adjusted for the 11.2-Year Cycle and Wars. Broken Line is the Ideal 9.3-Year Cycle.

Part V—The 13.0-Year Cycle

Summary: A strong rhythmic cycle about 13 years long has been present in manufacturing production for as far back as there are annual figures. This cycle turned down about a year ago. It is due to turn up again the latter part of 1959. It has an overall amplitude of 12.9%.

THE second most important cycle in manufacturing production isolated so far is one about 19 years long. Typically, from 1863 to date, its strength runs from 6.7% above trend at crest to 6.3% below trend at trough. This gives it a typical overall amplitude of 12.9% of trend.

In a series of figures as short as this, relative to the length of the cycle, it is impossible to determine the length of a cycle exactly. But to chart the cycle we must choose some one length. I have therefore chosen 13.0 years, but the actual length could be anywhere from 19.0 years to 13.1 years, or even, possibly, outside these limits.

If the length is 13.0 years, the crests come ideally at 1875.15 and every 13 years forward and backward from this date. Troughs fall ideally 6.5 years after crests. The current crest was due 1953.15. This cycle is therefore on its way down at the present time.

In a future report we shall look at the figures adjusted for the four cycles already isolated to see what other cycles may be present in manufacturing production. We will then project all isolated cycles into the future and synthesize them. But already we have a preview, I think, that although some depression ahead is to be expected, it is not likely to be catastrophic in depth or extent. *E.R.D.*

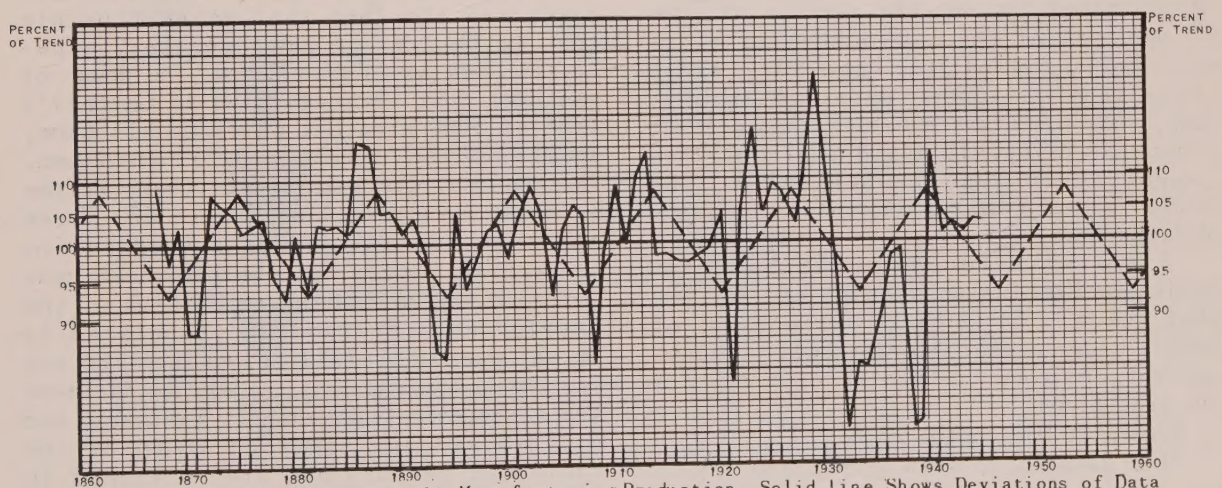


Fig. 3. The 13.0-Year Cycle in Manufacturing Production. Solid Line Shows Deviations of Data from Their 17-Year Moving Average, Both Adjusted for War and for the 54-, 11.2-, and 9.3-Year Cycles. The Broken Line is the Ideal 13.0-Year Cycle.

THE SEASONAL CYCLE AND ITS RELATION TO HUMAN CHARACTERISTICS AND ABILITIES

Part II Birth Months of Geniuses

Summary: Professor Huntington of Yale University found a definite tendency for persons of genius to be born in the first 3 months of the year. The evidence indicates that, within these three months, January is better than February, and February is better than March as a month in which to be born if you wish to be a genius. Take note and be governed accordingly!

IN our report for September 1952, I published for you the results of some research of the late Professor Ellsworth Huntington of Yale University, which shows that children conceived in May, June, and July stand a better than average chance of being girls and that children conceived in August, September, and October stand a better than average chance of being boys.

I now wish to quote further from Professor Huntington's book* to show you that the months of birth for persons of genius shows a characteristically different pattern than the months of birth for the rest of us.

Professor Huntington wrote:

"For decades or even generations there has been a wide-spread idea that men of genius are more likely to be born in February than in any other month. In America the fact that Washington was born in February 22 and Lincoln on February 12 has doubtless had something to do with this. Among the 31 presidents of the United States, no less than 26, or nearly 4 per month, were born in the 7 cooler months from October to April, and only 5, or 1 per month, in the warmer months from May to September. Among the 67 known birthdays of persons in the Hall of Fame at New York University, 27 or about 40 per cent occur in February, March, and April.

"Several tabulations of world geniuses indicate a similar tendency. Cattell (1903), Ireland (1925), Gini (1912), Kassel (1929), Pintner (1933), and Petersen (1936), are some of the writers who have discussed the fact that eminent people tend to be born in cool weather, especially from January to March. The group of geniuses most commonly used is Cattell's list of 1000 greatest names of all time, among whom the birthdays of 271 are known. The seasonal distribution of these births is shown in Curve *A* of Figure 68. Three other groups of leaders are added for comparison, namely, *B*, the 1226 Americans included in the fourteenth edition of the *Encylopaedia Britannica* (tabulated by Mr. Ziegler); *C*, 1374 scientists who are starred as outstanding leaders in *American Men of Science* (tabulated by Pintner); and *D*, 1078 leading American women of the ninteenth century who are mentioned in *A Woman of the Century* (tabulated by Mr. Ziegler). These four curves have been smoothed by our usual formula to eliminate the minor irregularities which are inevitable with small numbers of cases. All have a strongly developed maximum in January, February, or March, an equally distinct minimum in June, and a minor maximum in August, September, or October.

"Do the four curves show a winter maximum merely because births in general are most numerous as that time? So far as

**Season of Birth,* BY ELLSWORTH HUNTINGTON OF YALE UNIVERSITY, PUBLISHED BY JOHN WILEY & SONS, INC., NEW YORK. COPYRIGHT 1938. EXCERPTS AND CHARTS REPRINTED WITH PERMISSION.

the three American curves are concerned a negative answer is given by the lowest curve of Figure 68. This represents nearly 5000 ordinary Americans of old American stock whose birthdays were culled haphazard by Mr. Ziegler from genealogical records. They were born mainly from 1750 to 1885 at approximately the same time as the distinguished Americans of the three preceding groups. They represent the type from which distinguished Americans have mainly sprung. Moreover, their seasonal curve of births is essentially the same as that of old Massachusetts....and Michigan. It therefore seems probably that the births of distinguished Americans show a seasonal distribution quite different from that of ordinary people."

"...there is only 1 chance in millions that four diverse sets of data, such as form the basis of *A* to *D*, would accidentally give four curves showing the systematic qualities actually observed. Inasmuch as *E* for old New Englanders agrees essentially with the curves for entire states, we may feel confident that its form is even less likely than that of Curves *A* to *D* to be the result of mere chance. Therefore, we may feel fairly confident that eminent people really do show a seasonal distribution of births different from that of the population as a whole, and substantially like that of Curves *A* to *D*."

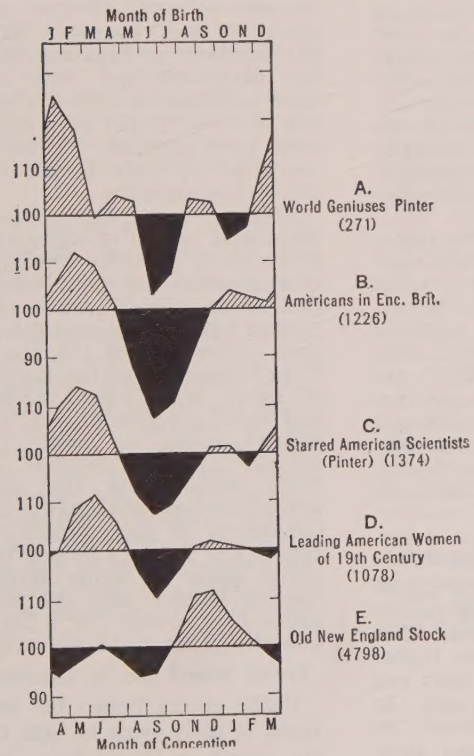


Fig. 68.—Season of Birth among Persons with Varying Degrees of Eminence.

NOTE THAT THE SEASONAL PATTERN FOR BIRTHS OF GENIUSES DIFFERS MARKEDLY FROM THE SEASONAL PATTERN OF ORDINARY FOLK (CURVE E).

"...the greater the degree of distinction, the greater is the tendency away from the ordinary seasonal distribution of births, and toward a maximum of births early in the year. Thus Curve *A* for world geniuses shows a very high maximum squarely in January, corresponding to conceptions in April. Its amplitude, that is, its range from maximum to minimum, amounts to 50 on a scale where 100 is the average. The Americans of Curve *B*, a group less distinguished than the people of Curve *A*, have their maximum in February, with an amplitude of 40 between maximum and minimum. The starred scientists (*C*), only about 7 per cent of whom are distinguished enough to find a place in the *Britannica*, also have their maximum in February, and its amplitude is only 32. The women's curve (*D*), belonging to a still less distinguished group, has its maximum in March, and the amplitude is only 22. Finally the curve for ordinary old Americans (*E*) is like that of the women in having its earlier maximum—a veryinsignificant one—in March. The range from this to the June level is only 7. The total amplitude of the whole curve, to be sure, is 18, but even this is less than the amplitude of any other curve in Figure 68.

"This resume of the curves of Figure 68 brings out two features. One is a steady tendency for the maximum to occur later in the season as we go from the greatest geniuses to other leaders and then down to ordinary people. The other is for the amplitude of the curves to decrease as we go from the more to the less competent."

E.R.D.

A 14- TO 16-YEAR CYCLE IN BEEF CATTLE PRICES*

By Gordon B. Nance.
(Extension Economist, College of Agriculture, University of Missouri.)

COLUMBIA, MO. — It is general knowledge that many animals and plants have habits which they tend to follow. Dogs turn around several times before they lie down; cows rise rear end first; soybeans bloom when the period of daylight is a certain length; in the spring jonquils bloom, hens "set" and women clean house. Keeping these habits in mind helps to understand what these things are likely to do under certain circumstances.

It is not so generally known that prices, also, have habits that they tend to follow. Recognition of these habits will help in deciding what prices are most likely to do under certain circumstances. This article deals with four habits of beef cattle prices.

Beef Cattle Price Cycles.

Beef cattle prices have a habit of having a high point in relation to the prices of other things each 14 to 16 years. Conversely, cattle prices have a low point at similar intervals—the low points being approximately midway between the high points. This swing from high to low and back to high again is called the cattle price "cycle."

The causes of these cycles are fairly easy to identify. When beef cattle prices—and profits of beef cattle production—are low, farmers market a larger percentage of their calf crop and their breeding herds. This decreases the breeding herds, increases marketings and the supply of dressed beef offered for sale and causes prices to fall still lower.

When breeding herds have been reduced to a point where marketings decline, the supply of beef decreases, prices rise and beef cattle production becomes more profitable. Farmers then keep larger percentages of calf crop and old cows for their breeding herds, and thereby increase breeding herds, reduce marketings and supplies of beef—which causes prices to rise still more. When herds have increased sufficiently to cause marketings to increase, prices begin to fall—and the price cycle begins all over again.

The reproduction rate of cattle and the time taken by farmers to react to price changes determine the length of the cycle—about fifteen years.

A second habit of cattle prices is that they decline about half from their high points to the following low points. The average dollar value of cattle at the four peaks in 1885, 1899, 1915, and 1929 was $30.17 per head. The average at the four low points in 1891, 1905, 1925 and 1934 was $16.04, or 47 per cent less. Averages of purchasing power declined from 135 to 68, or 50 per cent.

Average Lower Than Hog Prices

A third habit of cattle prices is to be lower than hog prices, most of the time. Since 1909, cattle prices have been higher than hog prices in ten years and lower in thirty-three years. In this whole period, prices received by farmers have averaged $9.61 for cattle and $10.76 for hogs—12 per cent higher.

Cattle prices have been higher than hogs since 1948. In the last four years, cattle prices have averaged $24.42 or 31 per cent above the $18.65 price of hogs.

A fourth habit of cattle prices is to be sharply lower than hog prices when the supply of beef exceeds the supply of pork.

Since 1903, there have been four years—1910, 1917, 1918 and 1947—when the supply of beef has been higher than the supply of pork. In those years the per capita supplies were sixty-two pounds of pork and sixty-eight pounds of beef—10 per cent more. Prices averaged $15.55 per hundred for hogs and $10.45 for cattle—33 per cent less. Beef supplies in 1953 are estimated to be 11 per cent higher than pork supplies. In March, cattle prices were 12 per cent below hog prices.

Another habit that may be mentioned is that of consumers, in spending a rather fixed portion of their spendable income for meat. This portion has ranged between 5½ and 6½ per cent, regardless of the size of their income or of the supplies of meat. If incomes increase and meat supplies do not, consumers spend the same percentage of their income, but more dollars, for the same amount of meat at higher prices. Conversely, if meat supplies increase and incomes do not, they spend about the same percentage of income and the same amount of money for a larger quantity of meat at lower prices.

Trend Would Be an Increase.

Cattle prices began the down trend of their cycle in 1952. Cattle numbers heretofore have continued to increase four or five years after prices began to decline. If the cattle cycles follow their previous pattern, cattle

*REPRINTED, WITH THE PERMISSION OF DR. NANCE, FROM THE WEEKLY STAR FARMER OF MAY 6, 1953.

numbers will increase from the present 94 million to above 100 million in 1956, at which time the supply of beef in the meat markets will be 20 per cent higher than at present.

Cattle prices usually decline about one-half on the down trend of their cycle. They have already fallen some 40 per cent from their last peak. If prices follow their previous pattern, they will decline another 15 per cent in the next two or three years.

Cattle prices in March were 12 per cent below hog prices, which is about their average relationship during the last forty-three years.

Beef supplies for 1953 are estimated at 11 per cent above pork supplies and cattle prices in March were 12 per cent below hog prices. If cattle and hog prices were in their usual relationship when beef supplies are 10 per cent higher, the difference in their prices would be nearly three times as much as at present. They would be in this usual relationship if hog prices were $23 and cattle prices $15.50. Consumer income is expected to remain at about present levels for a year or so.

Not a Prophecy.

The above is not to be construed to be a forecast that cattle numbers will increase to more than 100 million in 1956; or that prices will drop neither more nor less than 15 per cent in the next three or four years; or that cattle prices will fall 21 per cent in relation to hog prices. This is about what they have done in the past under somewhat similar conditions—but neither producers, consumers nor prices would exactly repeat former actions, even under identical conditions, and no two sets of conditions are ever identical.

One difference between present and past situations is that at the 1952 peak in prices, cattle numbers were nearly 50 per cent higher and cattle prices were 3½ times as high in dollars and nearly double in purchasing power than at any peak before World War II. This means, among other things, that in three or four years we will have at the meat counters the largest per capita supply of beef in history.

Another difference is that consumer preference for beef over pork has increased materially in the last decade. The continued substitution of mechanical power for human physical effort and the increasing prevalence and consciousness of overweight on the part of consumers have increased the preference for the leaner beef over the more fatty pork.

The rapid expansion in the production of vegetable oils and in their substitution for animal fats, has decreased the demand and prices for lard. These developments will tend to increase the price of cattle in relation to that of hogs.

Price Supports a Factor.

Also, there are now price supports for feed grains, dairy products and other things that farmers can produce instead of beef. If continued, these will tend to keep these supported prices higher in relation to beef prices, and hasten the shift away from beef production.

On the other hand, recent developments in improving pastures—in quantity of fovage produced per acre and in length of the grazing period—reduces the cost of producing beef and will tend to slow down the reduction in cattle numbers as prices decline. Just how all these will balance off, and the resultant effect on beer cattle prices in the next two or three years, is uncertain. But the above summarizations of price habits, and differences between the present and past situations, may add to the inforation on which a farmer can base his estimate as to what cattle prices will do in the next several years.

His Conclusions.

The reader has noted in this article the absence of definite statements as to what cattle prices are likely to do. The reason for this is that the present situation does not indicate definitely the future course of these prices.

But, unless an article means something it should not be written, and if it does mean anything, the writer is in the best position to know just what it is. For this reason, the writer, hesitantly, gives his conclusions. They are simply one man's opinions of what will emerge in a highly uncertain future. These are not so firmly held that he would argue with anyone who thinks differently. These conclusions are:

That the trend in cattle prices will be down for the next three or four years. Future declines are not likely to exceed 15 to 20 per cent, because most of those expected in the downswing of the cattle price cycle have already occurred.

That cattle prices are more likely to decline than to rise during the remainder of this year, but the declines, if any, probably will be slight.

That the difference between cattle and hog prices—now 12 per cent—is likely to widen, and may double, in the next ten months—due to the greater supplies of beef than of pork. This difference will be less than it would have been in former years with similar supplies—because preference for beef has increased.

CYCLES IN WHEAT PRICES AND IN WEATHER

IT is convenient to have for reference cycle lengths that have been discovered by various workers in various fields of natural and social science. With this thought in mind I am printing for you two pages from *Mainsprings of Civilization* by Ellsworth Huntington, published by John Wiley and Sons, Inc., and copyrighted in 1945:

"It used to be thought that the best way to study cycles is to examine long tables of statistics by the mathematical process known as harmonic analysis. At least twenty other methods, however, are now available and it is realized that the chief value of harmonic analysis lies in its suggestion of intervals of time that ought to be studied by the newer methods.

"A good example of harmonic analysis is Beveridge's study of wheat prices in Europe from 1500 to 1869. He gathered a large number of tables of prices from nearly fifty places in six regions, namely, Scotland and England, the Low Countries, France, North Germany, South Germany, and Austria. Each region received equal weight. Inasmuch as the data are drawn from a wide field and represent a period and area where agriculture was the dominate economic factor, there can be little doubt that the peaks and elevations of their plotted curve 'reflect substantially the harvest conditions' of the year in question.

"'A siege of a single town, as of Paris in 1590, may cause a rapid rise and fall of prices there, but the fate of a single town does not seriously affect the general index number. A general war, like the Thirty Years' War, or that of the Napoleonic period...may raise...the general level of prices, but after such a widespread distruction of goods and depreciation of money, prices cannot show a rapid and comparable fall. The only cause which can reasonably account for the characteristic peaks of the curve...is a fluctuation in

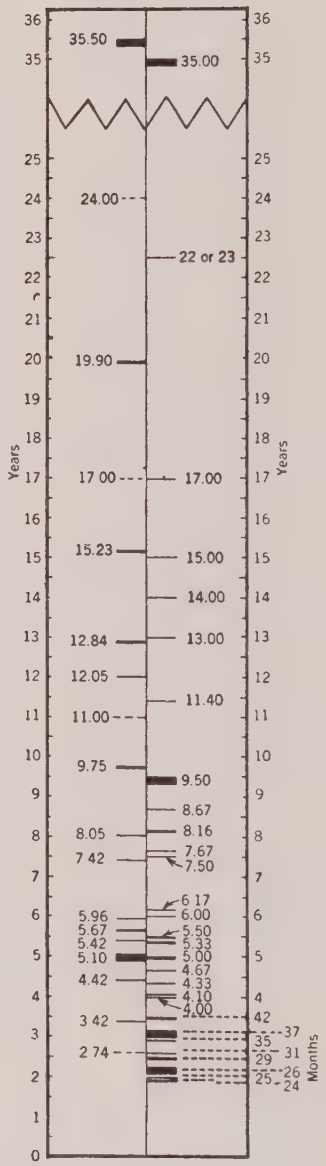


Figure 57. Cycles in Wheat Prices for Three Centuries (*after Beveridge*) (left), and in Weather for a Century in Europe (*after Brunt and Others*) (right).

the yield of harvests. That this was, in fact, the cause can be shown...practically in all cases by historical records'.[1] Beveridge recognizes that since 1800 the so-called credit cycle enters into the matter, but 'subject to one or two reserves the (prices) must be accepted as essentially a reflection of harvest success and harvest failure.'

"In Figure 57 the left-hand side sums up the length and intensity of all Beveridge's cycles. The number of cycles is astonishing, but some of the longer ones may be combinations of short ones. Two cycles, with lengths of about 5 and 35 years, stand out strongly both in the price of wheat and in various weather records. Seven, with lengths of 5.7, 9.8, 12.8, 15.2, 19.9, 54.0, and 68.0 are about as strong as the first two in prices, but appear only faintly or not at all in the weather. Six more are mildly evident in both prices and weather, and hints of others are indicated by fine dotted lines.

"The right-hand side of Figure 57 compares Beveridge's cycles with those found by Brunt in an elaborate harmonic analysis of rainfall, temperature, and atmospheric pressure in twelve European cities where records for at least a century are available.[2] The thickness of the lines on the right indicates the relative number of records in which Brunt and others whom he cites find the various periods. In addition to the 28 cycles shown here, Brunt describes 16 more with a length of less than 2 years. This illustrates the extreme complexity of the problem.

"The most obvious approaches to agreement between Beveridge and Brunt fall near 3½, 5, 8, 9½, and 35 years. One of the minor agreements is 7.50 years, according to Brunt, and 7.42 years, according to Beveridge. This is interesting because this cycle seems to be important in other respects. A prolonged study of annual tree growth, annual layers of clay deposited on lake bottoms (varves) and the laminae which represents similar layers in rocks hasconvinced Gillette that one of the most basic climatic cycles is 7.47 years in length. Clayton finds essentially this same period (7.54 years) in barometric pressure all the way from latitude above 60° in Siberia and Iceland to the tropics in Calcutta. He also finds it very clearly in sunspots and calls attention to the fact that it is practically one third of the period (22.3 years) covered by changes in the electrical polarity of sunspots."

1. BEVERIDGE, SIR WILLIAM H. 1922. "WHEAT PRICES AND RAINFALL IN WESTERN EUROPE." JOUR. ROY. ASTRON. SOC. 85:412-78. LONDON.

2. THE BASIC DATA ARE AS FOLLOWS: (A) RAINFALL AT MILAN, PADUA, LONDON, AND EDINBURGH; (B) PRESSURE AT EDINBURGH AND PARIS; (C) TEMPERATURE AT EDINBURGH, STOCKHOLM, LONDON, PARIS, BERLIN, AND VIENNA.

THE 6.33–MONTH CYCLE IN STOCK PRICES

Summary

A 6.33-month cycle, seemingly present in industrial common stock prices 1871 to date, in combination with the 6.41-month cycles reported upon in September, shows trading profits of 10.2% per annum for that half of the time when these two cycles go up and down at more or less the same time.

IN our report for September 1953 I told you about a 6.41-month cycle seemingly present in Standard & Poor's Corporation index of industrial common stock prices, 1871 to date.

Your gains from trading this cycle for the past 82 years would have averaged 7% per annum. But I told you no sensible person would try to trade on a knowledge of this cycle alone.

I now wish to tell you of a second short term cycle seemingly present in the same index of industrial common stock prices over the same period of time.

The 6.33-Month Cycle

This second cycle is 6.33 $\pm$ .005 months long, as nearly as I can measure it. It troughs ideally in mid-May 1871 and every 6.33 months thereafter. This puts the current trough at the end of August 1953 (month number 1632.98), the current crest early in December 1953, the next trough in March of 1954, and so on.

The overall amplitude of this cycle is about 1.1% of trend from trough to crest or vice versa.

Buying and selling on this cycle, 1871 to date, at the average index value for the month of high or low, would have given you an average annual profit of 4.1%. You can easily see that the 6.33-month cycle is only a little more than half as important as the 6.41-month cycle. However, many a mickle makes a muckle.

10.2% Per Annum Profit

Obviously half of the time the 6.41- and 6.33-month cycles would be in phase and would reinforce each other. The other half of the time they would be out of phase and would largely nullify each other. If you traded these two cycles in combination, 1871 to date, for the half of the time when they were together—and this is of course the only time you would have traded them—your gross gains would have averaged 10.2% per annum.

It is hardly necessary to point out to cycle students that 6.33- and 6.41-month cycles would combine to create a 6.37-month cycle which would gradually fade out and then reappear in reverse phase—crests where troughs "ought" to be, and vice versa.

It is hard to see how these cycles can be present in the market as a whole without also being present in the prices of individual stocks. Presumably, they are more important in some stocks than in others.

The interesting thing about these two cycles from the standpoint of cycle study is the fact that their lengths are so close together. If other cycles are present at more or less equal intervals above and below these lengths, we can expect 12 or 15 different cycles in the 6- to 7-month range.

The 6.41-Month Cycle More Important

A reconnaissance survey of stock market prices 1871—1900, made some months ago, suggests that the 6.41-month cycle is the most important single cycle in the general neighborhood of six months. Other cycles in this general area, if there are any, will therefore doubtless be of smaller amplitude, but at times a group of the smaller cycles could combine to create moves of importance.

It is also obvious from the dates given that these two cycles are now in reverse phase—that is, upside down in relation to each other. It will be several years before the inclusion of these two cycles will help any projection very much.

Even when in combination these two cycles cannot be seen by inspection or in unmanipulated data. We therefore cannot be sure that they are *rhythmic*. We do know however that they are present on the average in each major section of the data, and that in combination they are quite important.

E.R.D.

CYCLES OF ECONOMY AND WASTE* AND CYCLES OF CIVILIZATION

by Sir W. M. Flinders Petrie

IF we are to deal with the science of man, one of the first steps is to know our own position in the recurring cycles of civilization. Then we can see in what direction we are heading at present.

The cycle of economy and waste covers about 130 years. The waste began at 1535, 1660, 1790, 1920. The more austere periods revived in 1560, 1690, 1820; may we therefore look to 1950, or thereabouts? This is known in the northern saying "from clogs to clogs in three generations."

The long general cycle of civilization in Egypt bore the best work in 3700, 2600, 1550, 450 B.C., and A.D.760, an average of 1,115 years, resembling the 1,100 years of the "Great Year" known to the Etruscans. In each of the repetitions there was the same order of development—sculpture and architecture, painting, literature, mechanics, science and lastly wealth, the stage we now seem to have reached. Following that, other races break in for plunder, and after some centuries of mixture a new dominant rises with a fresh cycle.

A still larger cycle is that of race. The Sumerian, the Semite and the Perso-Aryan have successively been leaders of the East. We seem now to be nearing the end of Aryan rule, unless we can make recovery.

*REPRINTED FROM *Nature*, VOL. 142, OCT. 1, 1948.
SEE ADDITIONS TO THE LIBRARY, PAGE 278.

How it Came Out

1944 STOCK PRICE FORECAST

IN our report for October I printed for you a projection of certain cycles in the Standard & Poor's Combined Index which I had isolated early in 1944 for a large stock brokerage firm of New York City (the broken line in the chart below). I also printed on the same chart a curve showing actual prices as they had unfolded for the nine years, adjusted to a gold basis (the thin solid line on the curve below).

I have been asked to show the actual values, unadjusted to a gold basis. They are shown by the heavy solid line on the curve below.

For the benefit of new members I should perhaps repeat some remarks I made on page 273 when this chart (forecast and actual in gold only) was first printed.

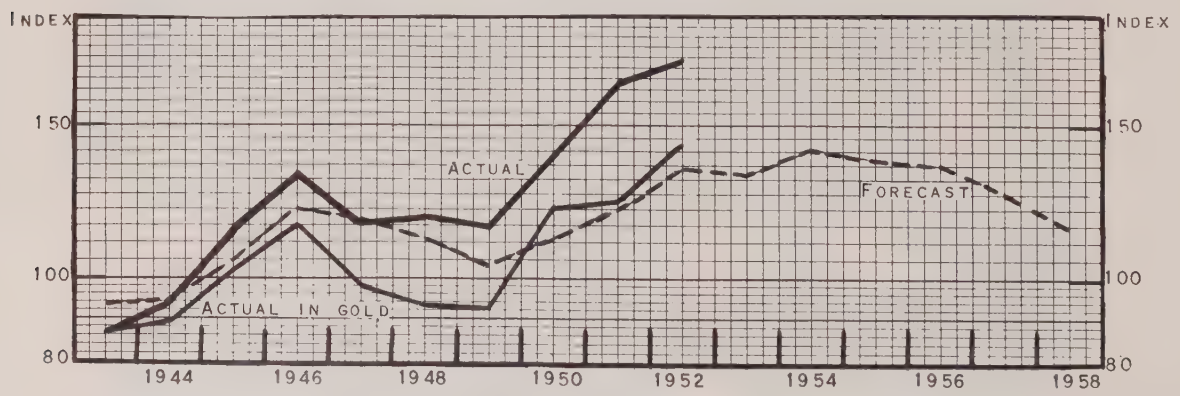
"The cycles I isolated from the annual averages [of the index] were 4½ years in length and longer. . .

"Can this forecast be depended upon for the future? Definitely not. The work was too crude. I probably included some cycles which were present in the 1854-1943 figures merely by accident. I probably got some of the lengths slightly wrong. I probably missed important cycles also present. Then too there are always random non-cyclic factors to take into account. Sooner or later the forecast will surely fail. Note too that it has no short cycles.

Significance

"It is hard to believe that the marked correspondence between these two curves could have come about by accident. Granted that the forecast contains a large element of beginner's luck, it cannot reasonably be *all* luck. In our cycle work we would seem to be definitely on the right track. Long range stock market forecasts that come true *can* be made. Ups and downs of the market *do* seem to register the combined effort of predictable rhythmic forces."

E.R.D.



Broken line, FORECAST, LONG WAVES ONLY, SYNTHESIS MADE IN 1944 PLUS TREND AT 1.8% PER ANNUM.
Light solid line, ACTUAL IN GOLD, STANDARD & POOR'S CORPORATION COMBINED INDEX ADJUSTED TO A GOLD BASIS 1943=100.
Heavy solid line, ACTUAL, STANDARD & POOR'S CORPORATION COMBINED INDEX, UNADJUSTED.

Questions & Answers

Question:

How did you first become interested in the subject of cycles?

Answer:

I happened to have been in the Department of Commerce at Washington at the time of the crash of 1929 and the depression which followed. One of my jobs was liaison with the economists of the country. I tried to find out from these economists what had caused the depression. All of them professed to know, but those *I* talked with, at least, all gave different reasons. This did not tend to inspire confidence in regard to their competence. I concluded that the economists really didn't know very much about it—a conclusion I still hold.

Along about this time I came in contact with people who had a "behavioristic" approach to economics. That is, instead of trying to figure out *why* things happen, they contented themselves with observing *how* things happen.

For instance if, in the last hundred years, the stock market has never declined more than X% in a day, it is a pretty good bet that it is not likely to decline more than X% between today and tomorrow. If nine times out of ten after a decline of such and such proportions there is a recovery of such and such proportions, it is a fair assumption, regardless of the reason why, that behavior of this sort may continue.

Some of these economic behaviorists had observed that some, at least, of the ups and downs of business came at reasonably regular time intervals. This fact provided an additional means of forecasting.

I then discovered that observers in other fields, such as biology, had observed similar behavior in the phenomena they studied and that variations on the surface of the sun likewise showed cycles of various lengths.

Finally I noticed that many of these wave lengths seem to be identical, thus suggesting the possibility of interrelationship. It seemed to me that in the subject of cycles we might have a clue to something very basic indeed. A conviction that this is so has grown with the years.

Question:

When can you determine whether a rise is the result of a cycle or due to a fundamental change in the growth trend?

Answer:

If you have correctly determined all the significant cycles present in a series of figures, and adjusted the figures to take account of these cycles, the remainder will be growth trend and random fluctuations.

If, then, you continue to adjust the figures as they unfold for the various cycles discovered, any change in the growth trend, in excess of normal accidental variation, can be determined immediately.

In actual practice, the trouble is that our series of figures are usually too short to enable us to determine the longer cycles with enough accuracy or assurance.

Question:

How much money would it take to "lick" the subject of cycles?

Answer:

I do not know. Suppose someone had asked one of the early chemists how much it would take to lick the subject of chemistry. He would not have known either. However, I should think that $25,000 a year for ten years, added to what has already been spent, would enable us to make a pretty good beginning.

Letters

Does This Man Speak for You?

Dear Mr. Dewey:

I have just finished reading the October report. I think, on a whole it is good, but it occurs to me you might like a reader's reactions.

In your Director's Letter you say that a knowledge of cycles indicates an increasing number of international battles reaching their climax in the early '60's. You then go on to give a lay opinion that we will be involved in these battles and that our involvement will include being atom bombed.

Even though you distinguish between your professional opinion and your lay opinion, if I were writing the Director's Letter I would leave out lay opinions as much as possible. You stand nothing to gain and more to lose.

The article on business failures was good, but a little too long and technical. After looking at all those charts, on each I looked to see what was going to happen next year. As, of course, they were all different, I was thoroughly confused by the time the synthesis came. It would be better, like the newspapers, to give the synthesis, and then to back it up with components.

As a subscriber I would like several things in your publication. I want predictions, amazes, probability, and a slight look-see into how it was arrived at.

Take wheat: I want a forecast by cycles. I want monthly figures (actual plotted). Then I want an analysis as to whether or not wheat prices are weakening. I want probabilities (7 to 5) that the 6-year low will come between January and June '54 (or whatever). Then I want to have random forces which may effect the prices brought to my attention—parity, war, weather, etc.

I want this done in brief fashion for—steel ingot production, crude oil, car loadings, prices of scrap steel, prices of copper, prices of wheat, wool tops, 90 stocks—price index (Standard & Poor), new construction starts, and a few others, maybe better.

I want continual looks at your forecasts against what happened to see how good you are and how much weight I should give your predictions. I want *your* appraisal of how good they are. I want probabilities as to when highs and lows are going to be, in ratio form within brackets. Low between January and June 1953—3 to 2, for example.

This is what I pay $10 for—the rest is interesting but filler—of general interest—and of interest in substantiating your method of forecasting.

Kiplinger, for example, says he has heard that the government will cut foreign spending $1,000,000. As a subscriber, I am interested that this is a good probability. I am not so much interested in how the government made the decision, or who Kiplinger got this tid-bit from.

I realize that you probably haven't done all this work and that you would hesitate to use the work of others. Maybe you could start off with just three or four. Your moving average trend might have to be extended by a temporary bringing up to date—unmoved—so that each month you would establish another month of moving average and another actual.

My suggestion would be to have at least one double spread each month on the above meat—maybe two double spreads.

I hope you will find these suggestions helpful.

Very sincerely yours,

Halesite, Long Island,
New York.

In Reply I Said:

Dear Mr.

I certainly appreciate your constructive suggestions, and all the time and effort you spent in putting them together.

I imagine that you speak for the great majority of our members. Most of them, I think, want just what you want.

In fact, I would like it myself! If you know anyone who can give *reliable* forecasts of the sort you mention just let me know. I will gladly give him $10, or a hundred times as much, if he wants it.

I know what you want, but it isn't in the cards to give it to you.

First of all, we are *not* operating a forecasting service. We are a scientific research agency studying rhythmic cycles in all aspects of nature, including man. We exist to benefit all mankind. Basically we are much more like Byrd's expedition to the South Pole than like *Business Week*, for example, even if we do study cycles in economic affairs.

Economics is one of the best places to study cycles. Where else can you get a homogeneous series of monthly figures January 1784 to date, for example? Not in weather. Not in sedimentary rock deposits. Not in the abundance of fish, insects, birds, or mammals.

The fact that economics is such a good area for cycle study means—largely by accident—that cycle study turns up a great many facts of tremendous value to those who must make economic decisions--*facts which are not available in any other way or from any other source.* It is your good luck, as a member of the Foundation for the Study of Cycles, that you have direct and immediate access to these facts as fast as they can be discovered and prepared for publication.

Unfortunately there are other facts that enter into economic situations, too. But these other non-rhythmic elements are completely outside of my field. As an oil expert, or a wool expert, or a steel expert I am probably more of a layman than you, yourself. That is the second reason why I cannot give you what you ask.

You chide me gently for expressing a lay opinion in regard to how the next war will unfold. You are doubtless justified. The same censure would apply ten fold if I expressed what would be just as truly lay opinions in regard to the stock market, the price of wheat, or the production of copper. Just because I happen to know a little something about cycles does not give me competence in respect to the non-rhythmic aspects of things.

I simply will not express opinions about things I do not know anything about. If I did, I am afraid I would feel like the New Deal administrator who was called upon by a friend of mine early in 1933.

"It makes me feel a little funny," said this fellow, motioning to a pile of papers he had just signed, "to authorize the expenditure of $1,000 000 for something I don't know the remotest thing about."

If he is still in government this man may, by now, be used to such activities. Perhaps in time I on my part could get used to posing as an expert on everything —but I am not going to try.

The net of it is that I can tell you a little something about rhythmic cycles, but that you are going to have to learn about the other factors from someone else.

There are, however, some valuable suggestions in your letter which can be acted upon. The one about newspaper style, especially, I shall try to put into effect. Only, give me a little time. At present writing the November report is at the printers—the December report is nearly set. We cannot take advantage of your ideas until January, at the earliest.

Thanks again for writing.

Cordially yours,

♦ ♦ ♦

A Letter from an Advertising Executive

Dear Sir:

As an advertising man I conjecture that your honest advertising pays off in a more than a usual number of replies. Am I right?

Sincerely yours,

In Reply I Said:

Dear Mr. :

Your conjecture is correct.

Yours truly,

Additions to the Library

"Tides in the Atmosphere," by J. Bartels, reprinted from *The Scientific Monthly*, Vol. XXXV, August, 1932, pp. 110-130, 21 pages, 28 figures, references. Gift of the Carnegie Institution of Washington.

In this paper Dr. Bartels discusses the mechanics of the atmosphere. He shows how the air, like sea water, is affected by the tidal forces.

Fig. 8 below, taken from Dr. Bartels's paper, shows how the diurnal (daily) variation of air temperature at Potsdam, Germany, in June, breaks down into 24-hour, 12-hour, 8-hour, and 6-hour waves.

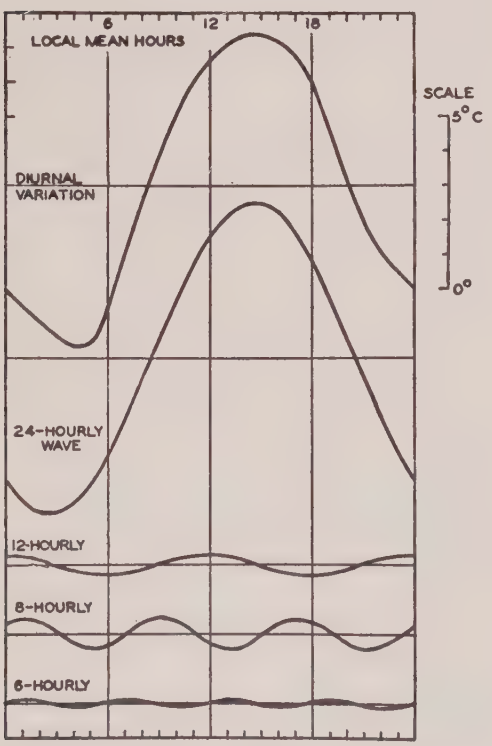


FIG. 8. HARMONIC ANALYSIS OF AIR-TEMPERATURE IN JUNE AT POTSDAM, GERMANY.

Fig. 9 shows a similar chart for barometric pressure at Colorado Springs in summer.

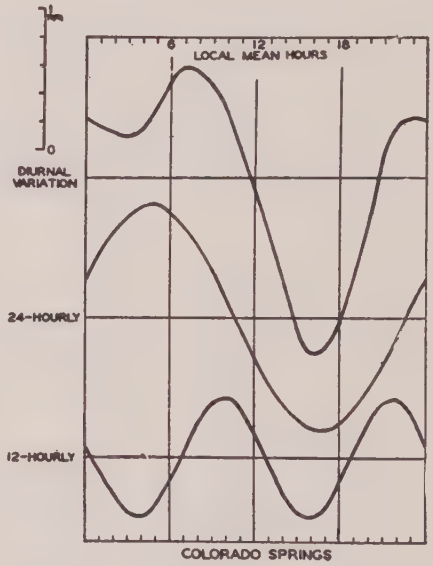


Fig. 9. Harmonic Analysis of Pressure in Summer.

• • •

"The Diurnal Cycle of the Powdery Mildew Erysiphe Polygoni," by Cecil E. Yarwood, reprinted from *Journal of Agricultural Research*, Vol. 52, No. 9, May 1936; 13 pages, 1 chart, 8 tables. Gift of the late Ellsworth Huntington.

A good factual statement of results of careful experiments, showing stimulative effect of light. No new principle.

THE LONG WAVES IN ECONOMIC LIFE

By

N. D. Kondratieff

Reprinted from
The Review of Economic Statistics
Volume XVII, Number 6
November, 1935

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NEW YORK 21, NEW YORK
1944

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VOLUME XVII NOVEMBER, 1935 NUMBER 6

THE LONG WAVES IN ECONOMIC LIFE

N. D. KONDRATIEFF

FOREWORD

The editors of the REVIEW OF ECONOMIC STATISTICS are happy to be able to present in translation the peculiarly important article by Professor Kondratieff, which, under the title "Die langen Wellen der Konjunktur," appeared in the *Archiv für Sozialwissenschaft und Sozialpolitik* in 1926 (vol. 56, no. 3, pp. 573–609). The combining circumstances of an increasing interest in "long waves" and the difficulty of securing access to the original article would alone justify translation and publication of Kondratieff's contribution to the theory of the trade cycle. In addition, the editors would take this means of indicating their intention from time to time of rendering available to the English-using world outstanding articles in foreign periodicals.

This translation of Professor Kondratieff's article was made by Mr. W. F. Stolper of Harvard University. Due to the limitations of space, the editors have taken the liberty to summarize certain sections of this translation. With the exception of a ten-page appendix of tabular material, however, all tables and charts have been included.

I. INTRODUCTION

THE idea that the dynamics of economic life in the capitalistic social order is not of a simple and linear but rather of a complex and cyclical character is nowadays generally recognized. Science, however, has fallen far short of clarifying the nature and the types of these cyclical, wave-like movements.

When in economics we speak of cycles, we generally mean seven to eleven year business cycles. But these seven to eleven year movements are obviously not the only type of economic cycles. The dynamics of economic life is in reality more complicated. In addition to the above-mentioned cycles, which we shall agree to call "intermediate," the existence of still shorter waves of about three and one-half years' length has recently been shown to be probable.[1]

But that is not all. There is, indeed, reason to assume the existence of long waves of an average length of about 50 years in the capitalistic economy, a fact which still further complicates the problem of economic dynamics.

II–III. METHOD

[Sections II and III of Kondratieff's exposition may be summarized as follows:

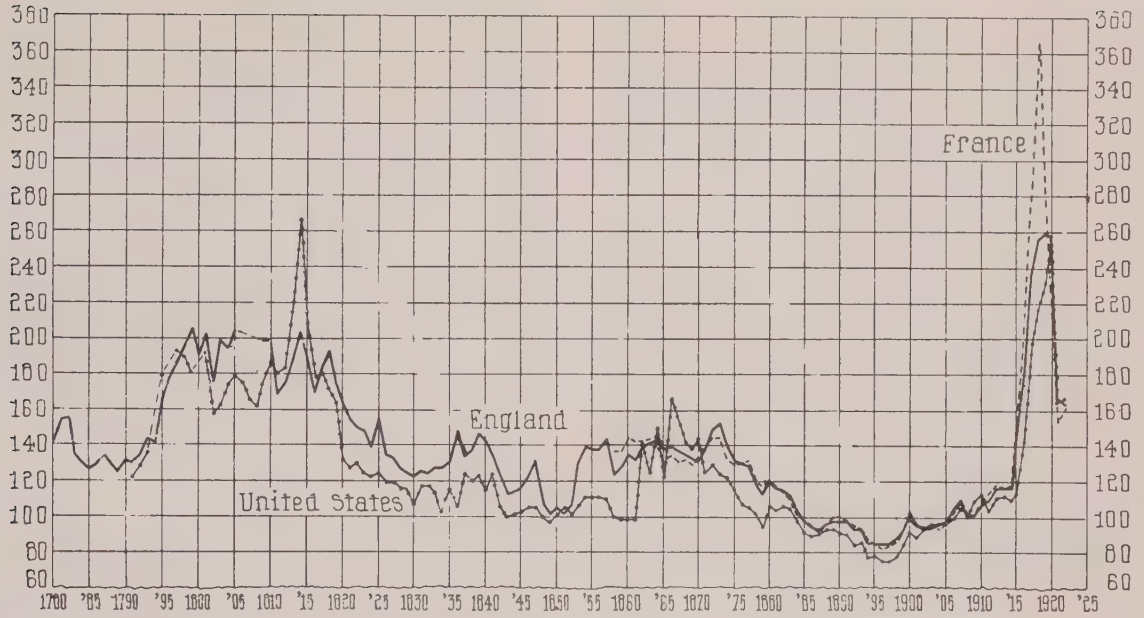
The succeeding study is to be confined solely to an inquiry into various problems connected with these long waves. Investigation here is made difficult by the fact that a very long period of observation is presupposed. We have, however, no data before the end of the eighteenth century and even the data that we do have are too scanty and not entirely reliable. Since the material relating to England and France is the most complete, it has formed the chief basis of this inquiry. The statistical methods used were simple when no secular trend was present in the series. If the series displayed a secular trend, as was the case among physical series, the first step was to divide the annual figures by the population, whenever this was logically possible, in order to allow for changes in territory. Then the secular trend was eliminated by the usual statistical methods applied to each series as a whole; and Kondratieff refers specifically to the methods presented by Dr. Warren M. Persons in this REVIEW in 1919 and 1920. The deviations from the secular trend were then smoothed by a nine-year moving average, in order to eliminate the seven to eleven year business cycles, the short cycles, and random fluctuations possibly present.]

IV. THE WHOLESALE PRICE LEVEL

While the index of French prices goes back only to the end of the 1850's, the English and American indices date back to the close of the eighteenth century. In order not to overburden

[1] Cf. J. Kitchin, "Cycles and Trends in Economic Factors," REVIEW OF ECONOMIC STATISTICS [hereafter referred to as "this REVIEW"], V (1923), pp. 10–16.

CHART 1. — INDEX NUMBERS OF COMMODITY PRICES*
(*1901–10 = 100*)



* The *French* data are taken from the *Annuaire Statistique* [Statistique Générale de la France], 1922, p. 341; the index number has been recalculated on a gold basis through use of dollar-franc exchange rates.

For *England*, there is for 1782–1865 the index of Jevons; for 1779–1850, a new index number, computed by Silberling and published in this REVIEW, v (1923); for the period after 1846, we have Sauerbeck's index, which at present is carried on by the *Statist*. Since Silberling's index is based upon more complete data of the prices of individual commodities than that of Jevons, we have used the former for the period 1780–1846. From 1846 on we use Sauerbeck's index number. Both indices have been tied together on the basis of their relation during 1846–50, for which period they are both available; after this procedure, we have shifted the series to a new base, 1901–10. For the period 1801–20 and since 1914, in which periods England was on a paper standard, the index numbers have been recalculated on a gold basis.

For the *United States*, we use the following series, which have been tied together: for 1791–1801, H. V. Roelse (*Quarterly Publications of the American Statistical Association*, December, 1917); 1801–25, A. H. Hansen (*ibid.*, December, 1915); 1825–39, C. H. Juergens (*ibid.*, June, 1911); 1840–90, Falkner (Report from the Committee on Finance of the United States Senate on *Wholesale Prices, Wages, and Transportation*, 52d Congress, 2d session, Report No. 1394, Part 1 [Washington: Government Printing Office, March 3, 1893]); since 1890, the B. L. S. index. All index numbers are on the base 1901–10. For the Greenback period (1862–78), they have been recalculated on a gold basis. All data [except Silberling's index] are taken from the *Annuaire Statistique*, 1922 [which utilizes the sources above cited].

this study with figures, the statistical data are presented exclusively in the form of charts.[1]

The index numbers of prices plotted on Chart 1 have been neither smoothed nor treated in any other way. Nevertheless, a mere glance at the chart shows that the price level, despite all deviations and irregularities, exhibits a succession of long waves.

The upswing of the first long wave embraces the period from 1789 to 1814, i.e., 25 years; its decline begins in 1814 and ends in 1849, a period of 35 years. The cycle is, therefore, completed in 60 years.[2]

The rise of the second wave begins in 1849 and ends in 1873, lasting 24 years. The turning point, however, is not the same in the United States as in England and France; in the United States the peak occurs in the year 1866, but this is to be explained by the Civil War and casts no doubt on the unity of the picture which the course of the wave exhibits in the two continents. The decline of the second wave begins in 1873 and ends in 1896, a period of 23 years. The length of the second wave is 47 years.

[1] [Ten pages of tabular material were given by Kondratieff at the end of his article. The charts presented in this translation are not merely reproductions of those in the original article but have been drawn anew from the data given in his tabular appendix. A few slight discrepancies between the new charts and those of Kondratieff were discovered, but in no case were the discrepancies significant.—Editors.]

[2] In the upswing, the English index exhibits several peaks, which fall in the years 1799, 1805, 1810, and 1814; but since after the year 1814 a distinctly downward tendency can be observed, we regard this year as the turning point.

The upward movement of the third wave begins in 1896 and ends in 1920, its duration being 24 years. The decline of the wave, according to all data, begins in 1920.

It is easily seen that the French prices after the close of the 1850's move generally parallel to the English and American prices. It is, therefore, very probable that this parallelism existed in the preceding period as well.

We conclude, therefore, that three great cycles are present in the movement of the price level during the period since the end of the 1780's, the last of which is only half completed. The waves are not of exactly the same length, their duration varying between 47 and 60 years. The first wave is the longest.

V. THE RATE OF INTEREST

The course of the interest rate can be seen most conveniently from the movement of the discount rate and the quotations of interest-bearing securities. Because the latter depend less on random fluctuations and reflect more accurately the influence of long-run factors, we use here only the quotations of state bonds.

CHART 2

QUOTATIONS OF INTEREST-BEARING SECURITIES

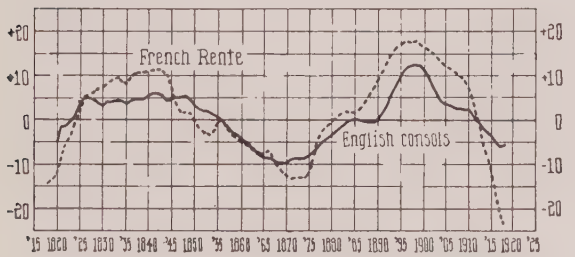


Chart 2 shows the quotations of the French Rente[1] and of English consols.[2] Both have a secular trend during the period of observation. The chart shows the deviations from the secular trend smoothed by means of a nine-year moving average.

The quotations of interest-bearing securities manifest, as is well known, a movement opposite to that of general business activity and of the interest rate. Therefore, if long waves are operative in the fluctuations of the interest rate, the movement of bond quotations must run in a direction counter to that of commodity prices. Just this is shown in our chart, which exhibits clearly the long waves in the movement of the quotations and consequently of the interest rate.

The chart starts only after the Napoleonic Wars, i.e., about the time that the first long wave of commodity prices had reached its peak; it does not cover the period of the upswing of the latter. Considering the data at hand, however, we may suppose that the quotations of state bonds took part in this movement also.

English consols actually manifest a decidedly downward tendency between 1792 and 1813. Their quotation in 1792 is 90.04; in 1813, on the other hand, it is 58.81. Although they drop most rapidly in the years 1797 and 1798, yet this steep decline is only an episode, and the general downward tendency from 1792 to 1813 stands out quite clearly.[3]

Accordingly, the period from the beginning of the 1790's up to 1813 appears to be the phase of rising interest rates. This period agrees perfectly with that of the rising wave of commodity prices.

The wave of bond quotations rises after 1813[4] — or the wave of the interest rate declines — even till the middle of the forties. (See the chart.) According to the unsmoothed data, consols reached their peak in 1844; the Rente, in 1845. With this, the first great cycle in the movement of the interest rate is completed.

The downward movement of bond quotations (or the rise of the interest rate) during the second cycle lasts from 1844–45 to 1870–74.[5] From this time onward until 1897, the market price of interest-bearing securities rises again, and consequently the interest rate goes down. With this, the second great cycle is completed.

The new decline of the quotations (rise in the

[1] Until 1825 the quotations of the five-per-cent Rente, after this the quotations of the three-per-cent Rente. In order to connect both series, we have first computed relatives with the base 1825–30 for both series. Then we shifted the base of the combined series to 1901–10, in order to make them comparable with the price curve. The original data are taken from the *Annuaire Statistique* [Statistique Générale de la France], 1922.

[2] According to the data in William Page, ed., *Commerce and Industry*, Vol. 2 (London, 1919), statistical tables, pp. 224–25. Relatives have been calculated from the figures, with the base 1901–10.

[3] Cf. N. J. Silberling, "British Financial Experience, 1790–1830," this REVIEW, 1 (1919), p. 289.

[4] The first years have disappeared from our chart because of the use of the nine-year moving average.

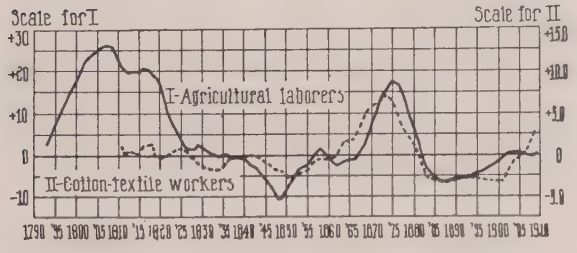
[5] According to the original data, consols actually reach their lowest point in 1866, but the general tendency continues to be one of decline until 1874. The slump of quotations in 1866 is connected with the increase in the interest rate just preceding the money-market crisis of that year, and with the Austro-Prussian War.

rate of interest) lasts from 1897 to 1921. Thus the existence of great cycles in the movement of the interest rate appears very clearly.[1] The periods of these cycles agree rather closely with the corresponding periods in the movement of wholesale commodity prices.

VI–VII. WAGES AND FOREIGN TRADE

[In Section VI, Kondratieff examines the course of weekly wages of workers in the English cotton-textile industry since 1806 and of English agricultural laborers since 1789.[2] The original wage data are reduced to a gold basis and then expressed in the form of index numbers with 1892 as the base year. Chart 3 presents these

CHART 3.— WAGES IN ENGLAND



wage figures as deviations from trend, smoothed by use of a nine-year moving average. Kondratieff devotes the remainder of this section to a description of the series presented in Chart 3, from which analysis he concludes that, despite the scantiness of the available data, "long waves are undoubtedly present in the movement of wages, the periods of which correspond fairly well with those in commodity prices and the interest rate."

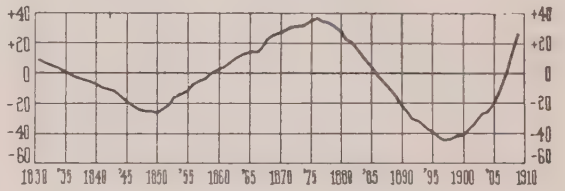
[1] The existence of these cycles is also confirmed by several other studies: P. Wallich, "Beiträge zur Geschichte des Zinsfusses von 1800 bis zur Gegenwart," *Jahrbücher für Nationalökonomie und Statistik*, III. Folge, Vol. 42, pp. 289–312; J. Lescure, "Hausses et Baisses Générales des Prix," *Revue d'Economie Politique*, Nr. 4 (1912); R. A. Macdonald, "The Rate of Interest Since 1844," *Journal of the Royal Statistical Society*, LXXV (1912), pp. 361–79; T. T. Williams, "The Rate of Discount and the Price of Consols," *ibid.*, pp. 380–400. Also *ibid.*, pp. 401–11, the discussion of the last-mentioned studies, especially the speech of E. L. Hartley, pp. 404–06.

[2] [Earnings of cotton-textile workers for 1806–1906 are taken from G. H. Wood, *The History of Wages in the Cotton Trade* (London, 1910), p. 127; beginning with 1906, they are from the *Abstract of Labour Statistics*.

For agricultural laborers, wage data for 1789–1896 are from A. L. Bowley, "The Statistics of Wages in the United Kingdom During the Last Hundred Years: Part IV, Agricultural Wages," *Journal of the Royal Statistical Society*, LXII (1899), pp. 555 ff. Thereafter, the figures are from Page, *op. cit.* The data refer to England and Wales.]

For his foreign-trade series presented in Section VII, Kondratieff takes the sum of French exports and imports. The figures were first corrected for population changes, and thereafter the secular trend (in the form of a second-degree parabola) was eliminated. The resulting deviations, smoothed by use of a nine-year moving average, are presented in Chart 4. After an

CHART 4.— FRENCH FOREIGN TRADE



examination of the chart, the author concludes that the data on foreign trade also show the existence of two great cycles, the periods of which coincide with those observed in the other data.]

VIII. THE PRODUCTION AND CONSUMPTION OF COAL AND PIG IRON, AND THE PRODUCTION OF LEAD

So far we have examined the movements only of such magnitudes, sensitive to changes in business conditions, as possess either a purely value character, e.g., commodity prices, interest rates, and wages, or at least a mixed character such as the data on foreign trade. Our study, however, would lose much of its force if we did not also analyze the behavior of purely physical series.

For this purpose we choose English coal production,[3] and French consumption of coal,[4] as well as the English production of pig iron and of lead.[5] We divided the original figures by the population, and eliminated from the resulting series the secular trends. The deviations from the lines of trend, after being smoothed by use of a nine-year moving average, were then analyzed. The results are shown in Chart 5.

Continuous data are available, unfortunately, only for the period after the 1830's, in part even only after the 1850's. Consequently, only one and one-half to two great cycles can be shown, but these appear with striking clarity in both charts.

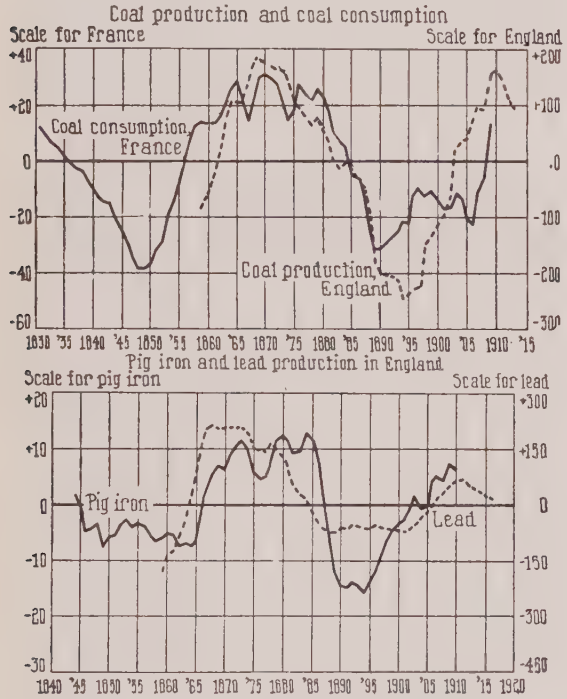
[3] According to the data of W. Page, *op. cit.*

[4] *Annuaire Statistique*, 1908 and 1922.

[5] According to *British and Foreign Trade and Industry*, and the *Statistical Abstract* [*for the United Kingdom*].

There is a retardation in the increase of coal consumption [in France] until the end of the 1840's, then the advance becomes more rapid and reaches its peak in 1865, according to the smoothed curve (on the chart), and in 1873, according to the unsmoothed curve. In the latter year, English coal production also reaches a maximum, according to the unsmoothed curve. Then

CHART 5.— CONSUMPTION OF COAL IN FRANCE AND PRODUCTION OF COAL, PIG IRON, AND LEAD IN ENGLAND



follows the decline, which comes to an end in 1890–94, giving way to a new long upswing. So we observe in the data relative to the rapidity in the increase of coal production and coal consumption nearly the whole of two large cycles, the periods of which correspond closely to the periods we have already found when considering other series.

Similarly, English production of pig iron and lead indicates sufficiently clearly the existence of one and one-half large cycles.

IX. OTHER SERIES

For the sake of brevity, we break off here the systematic analysis of the long waves in the behavior of individual series. We have also examined other data, some of which likewise showed the same periods as those mentioned above, although several other series did not show the cycles with the same clarity. Value series which show long waves are the deposits and the portfolio of the Bank of France, and deposits at the French savings banks; series of a mixed (quantity x price) character are French imports and English imports, and total English foreign trade. As regards the movement of indices of a physical character, the existence of long waves has been established in the coal production of the United States, of Germany, and of the whole world; in the pig-iron production of the United States and of Germany and of the whole world; in the lead and coal production of the United States; in the number of spindles of the cotton industry in the United States; in the cotton acreage in the United States and the oat acreage in France, etc.

It was absolutely impossible, on the other hand, to establish long waves in French cotton consumption; in the wool and sugar production of the United States; and in the movement of several other series.

X. STATISTICAL FINDINGS

The evidence we have presented thus far permits some conclusions.

(1) The movements of the series which we have examined running from the end of the eighteenth century to the present time show long cycles. Although the statistical-mathematical treatment of the series selected is rather complicated, the cycles discovered cannot be regarded as the accidental result of the methods employed. Against such an interpretation is to be set the fact that these waves have been shown with about the same timing in all the more important of the series examined.

(2) In those series which do not exhibit any marked secular trend — e.g., prices — the long cycles appear as a wave-like movement about the average level. In the series, on the other hand, the movement of which shows such a trend, the cycles accelerate or retard the rate of growth.

(3) In the several series examined, the turning points of the long waves correspond more or less accurately. This is shown clearly by Table 1, which combines the results of the investigation not only of the data considered above but also of several other series.[1]

[1] Table 1 enumerates the maxima and minima according to the original data. The problem of the most accurate method

TABLE 1

Country and series	First cycle		Second cycle		Third cycle	
	Beginning of rise	Beginning of decline	Beginning of rise	Beginning of decline	Beginning of rise	Probable beginning of decline
France						
1. Prices	....	....	....	1873	1896	1920
2. Interest rate	....	1816*	1844	1872	1894	1921
3. Portfolio of the Bank of France	....	1810*	1851	1873	1902	1914
4. Deposits at the savings banks	....	....	1844	1874	1892	....
5. Wages of coal miners	....	....	1849	1874	1895	....
6. Imports	....	....	1848	1880	1896	1914
7. Exports	....	....	1848	1872	1894	1914
8. Total foreign trade	....	....	1848	1872	1896	1914
9. Coal consumption	....	....	1849	1873	1896	1914
10. Oat acreage[1]	....	....	1850*	1875	1892	1915
England						
1. Prices	1789	1814	1849	1873	1896	1920
2. Interest rate	1790	1816	1844	1874	1897	1921
3. Wages of agricultural laborers	1790	1812–17	1844	1875	1889	....
4. Wages of textile workers	....	1810*	1850†	1874	1890	....
5. Foreign trade	....	1810*	1842‡	1873	1894	1914
6. Coal production	....	....	1850*	1873	1893	1914
7. Pig iron production	....	....	....	1871§	1891	1914
8. Lead production	....	....	....	1870	1892	1914
United States						
1. Prices	1790	1814	1849	1866	1896	1920
2. Pig iron production	....	....	....	1875–80	1900	1920
3. Coal production	....	....	....	1893	1896	1918
4. Cotton acreage	....	....	....	1874–81	1892–95	1915
Germany						
Coal production	....	....	....	1873‖	1895	1915
Whole world[2]						
1. Pig iron production	....	....	....	1872¶	1894	1914
2. Coal production	....	....	....	1873	1896	1914

[1] Reversed cycles.
[2] The data which refer to the whole world have not been corrected for population changes.
* Approximate dates.
† Another minimum falls in the year 1835.
‡ Other minima lie in the years 1837 and 1855.
§ Another maximum falls in the year 1881.
‖ Another maximum falls in the year 1883.
¶ Another maximum falls in the year 1882.

It is easy to see from this table that there is a very close correspondence in the timing of the wave movements of the series in the individual countries, in spite of the difficulties present in the treatment of these data. Deviations from the general rule that prevails in the sequence of the cycles are very rare. It seems to us that the absence of such exceptions is more remarkable than would be their presence.

(4) Although for the time being we consider it to be impossible to fix exactly upon the years that marked the turning points of the long cycles, and although the method according to which the statistical data have been analyzed

for the determination of the maxima and minima would deserve a special analysis; at present we leave this question open. We believe only that the indicated turning points are the most probable ones.

permits an error of 5–7 years in the determination of the years of such turnings, the following limits of these cycles can nevertheless be presented as being those most probable:

First long wave	1. The rise lasted from the end of the 1780's or beginning of the 1790's until 1810–17. 2. The decline lasted from 1810–17 until 1844–51.
Second long wave	1. The rise lasted from 1844–51 until 1870–75. 2. The decline lasted from 1870–75 until 1890–96.
Third long wave	1. The rise lasted from 1890–96 until 1914–20. 2. The decline probably begins in the years 1914–20.

(5) Naturally, the fact that the movement of the series examined runs in long cycles does not yet prove that such cycles also dominate the movement of all other series. A later examination with this point especially in mind will have to be made to show which ones of these share the described wave-like movement. As already pointed out, our investigation has also extended to series in which no such waves were evident. On the other hand, it is by no means essential that the long waves embrace all series.

(6) The long waves that we have established above relative to the series most important in economic life are international; and the timing of these cycles corresponds fairly well for European capitalistic countries. On the basis of the data that we have adduced, we can venture the statement that the same timing holds also for the United States. The dynamics in the development of capitalism, however, and especially the timing of the fluctuations in the latter country may have peculiarities.

XI. EMPIRICAL CHARACTERISTICS

We were led to these conclusions by the study of statistical series characterizing the movement of the capitalist economy. From another point of view, the historical material relating to the development of economic and social life as a whole confirms the hypothesis of long waves. We neither can nor shall undertake here an analysis of this material. Nevertheless, several general propositions which we have arrived at concerning the existence and importance of long waves may be presented.

(1) The long waves belong really to the same complex dynamic process in which the intermediate cycles of the capitalistic economy with their principal phases of upswing and depression run their course. These intermediate cycles, however, secure a certain stamp from the very existence of the long waves. Our investigation demonstrates that during the rise of the long waves, years of prosperity are more numerous, whereas years of depression predominate during the downswing.[1]

(2) During the recession of the long waves, agriculture, as a rule, suffers an especially pronounced and long depression. This was what happened after the Napoleonic Wars; it happened again from the beginning of the 1870's onward; and the same can be observed in the years after the World War.[2]

(3) During the recession of the long waves, an especially large number of important discoveries and inventions in the technique of production and communication are made, which, however, are usually applied on a large scale only at the beginning of the next long upswing.

(4) At the beginning of a long upswing, gold production increases as a rule, and the world market [for goods] is generally enlarged by the assimilation of new and especially of colonial countries.

(5) It is during the period of the rise of the long waves, i.e., during the period of high tension in the expansion of economic forces, that, as a rule, the most disastrous and extensive wars and revolutions occur.

It is to be emphasized that we attribute to these recurring relationships an empirical character only, and that we do not by any means hold that they contain the explanation of the long waves.

XII. THE NATURE OF LONG WAVES

Is it possible to maintain that the existence of long cycles in the dynamics of the capitalist economy is proved on the basis of the preceding statements? The relevant data which we were able to quote cover about 140 years. This period comprises two and one-half cycles only. Although the period embraced by the data is sufficient to

[1] Cf. A. Spiethoff, "Krisen," (*Handwörterbuch der Staatswissenschaften*, 4th edition).

[2] Cf. Ernle, *English Farming Past and Present* (London, 1922), and G. F. Warren and F. A. Pearson, *The Agricultural Situation* (New York, 1924).

decide the question of the existence of long waves, it is not enough to enable us to assert beyond doubt the cyclical character of those waves. Nevertheless we believe that the available data are sufficient to declare this cyclical character to be very probable.

We are led to this conclusion not only by the consideration of the factual material, but also because the objections to the assumption of long cyclical waves are very weak.

It has been objected that long waves lack the regularity which business cycles display. But this is wrong. If one defines "regularity" as repetition in regular time-intervals, then long waves possess this characteristic as much as the intermediate ones. A strict periodicity in social and economic phenomena does not exist at all — neither in the long nor in the intermediate waves. The length of the latter fluctuates at least between 7 and 11 years, i.e., 57 per cent. The length of the long cycles fluctuates between 48 and 60 years, i.e., 25 per cent only.

If regularity is understood to be the similarity and simultaneity of the fluctuations of different series, then it is present to the same degree in the long as in the intermediate waves.

If, finally, regularity is understood to consist in the fact that the intermediate waves are an international phenomenon, then the long waves do not differ from the latter in this respect either.

Consequently, there is no less regularity in the long waves than in the intermediate ones, and if we want to designate the latter as cyclical, we are bound not to deny this characterization to the former.

It has been pointed out [by other critics] that the long waves — as distinct from the intermediate ones which come from causes within the capitalistic system — are conditioned by casual, extra-economic circumstances and events, such as (1) changes in technique, (2) wars and revolutions, (3) the assimilation of new countries into the world economy, and (4) fluctuations in gold production.

These considerations are important. But they, too, are not valid. Their weakness lies in the fact that they reverse the causal connections and take the consequence to be the cause, or see an accident where we have really to deal with a law governing the events. In the preceding paragraphs, we have deliberately, though briefly, considered the establishment of some empirical rules for the movement of long waves. These regularities help us now to evaluate correctly the objections just mentioned.

1. *Changes in technique* have without doubt a very potent influence on the course of capitalistic development. But nobody has proved them to have an accidental and external origin.

Changes in the technique of production presume (1) that the relevant scientific-technical discoveries and inventions have been made, and (2) that it is *economically* possible to use them. It would be an obvious mistake to deny the creative element in scientific-technical discoveries and inventions. But from an objective viewpoint, a still greater error would occur if one believed that the direction and intensity of those discoveries and inventions were entirely accidental; it is much more probable that such direction and intensity are a function of the necessities of real life and of the preceding development of science and technique.[1]

Scientific-technical inventions in themselves, however, are insufficient to bring about a real change in the technique of production. They can remain ineffective so long as economic conditions favorable to their application are absent. This is shown by the example of the scientific-technical inventions of the seventeenth and eighteenth centuries which were used on a large scale only during the industrial revolution at the close of the eighteenth century. If this be true, then the assumption that changes in technique are of a random character and do not in fact spring from economic necessities loses much of its weight. We have seen before that the development of technique itself is part of the rhythm of the long waves.

2. *Wars and revolutions* also influence the course of economic development very strongly. But wars and revolutions do not come out of a clear sky, and they are not caused by arbitrary acts of individual personalities. They originate from real, especially economic, circumstances. The assumption that wars and revolutions acting

[1] One of the best and most compelling arguments for the assumption that scientific and technical inventions and discoveries are not made accidentally but are intimately connected with the needs of practical life is given by the numerous cases in which the same inventions and discoveries are made at the same time at different places and entirely independently of one another. Cf. the long list of such cases in W. F. Ogburn, *Social Change* (New York, 1924), p. 90. Cf. also Dannemann, *Die Naturwissenschaften in ihrer Entwickelung und in ihrem Zusammenhange* (Leipzig, 1923).

from the outside cause long waves evokes the question as to why they themselves follow each other with regularity and solely during the upswing of long waves. Much more probable is the assumption that wars originate in the acceleration of the pace and the increased tension of economic life, in the heightened economic struggle for markets and raw materials, and that social shocks happen most easily under the pressure of new economic forces.

Wars and revolutions, therefore, can also be fitted into the rhythm of the long waves and do not prove to be the forces from which these movements originate, but rather to be one of their symptoms. But once they have occurred, they naturally exercise a potent influence on the pace and direction of economic dynamics.

3. As regards the *opening-up of new countries for the world economy*, it seems to be quite obvious that this cannot be considered an outside factor which will satisfactorily explain the origin of long waves. The United States have been known for a relatively very long time; for some reason or other they begin to be entangled in the world economy on a major scale only from the middle of the nineteenth century. Likewise, the Argentine and Canada, Australia and New Zealand, were discovered long before the end of the nineteenth century, although they begin to be entwined in the world economy to a significant extent only with the coming of the 1890's. It is perfectly clear historically that, in the capitalistic economic system, new regions are opened for commerce during those periods in which the desire of old countries for new markets and new sources of raw materials becomes more urgent than theretofore. It is equally apparent that the limits of this expansion of the world economy are determined by the degree of this urgency. If this be true, then the opening of new countries does not provoke the upswing of a long wave. On the contrary, a new upswing makes the exploitation of new countries, new markets, and new sources of raw materials necessary and possible, in that it accelerates the pace of capitalistic economic development.

4. There remains the question whether the *discovery of new gold mines*, the *increase in gold production*, and a consequent *increase in the gold stock* can be regarded as a casual, outside factor causing the long waves.

An increase in gold production leads ultimately to a rise in prices and to a quickening in the tempo of economic life. But this does not mean that the changes in gold production are of a casual, outside character and that the waves in prices and in economic life are likewise caused by chance. We consider this to be not only unproved but positively wrong. This contention originates from the belief, first, that the discovery of gold mines and the perfection of the technique of gold production are accidental and, secondly, that every discovery of new gold mines and of technical inventions in the sphere of gold production brings about an increase in the latter. However great may be the creative element in these technical inventions and the significance of chance in these discoveries, yet they are not entirely accidental. Still less accidental — and this is the main point — are the fluctuations in gold production itself. These fluctuations are by no means simply a function of the activity of inventors and of the discoveries of new gold mines. On the contrary, the intensity of inventors' and explorers' activity and the application of technical improvement in the sphere of gold production, as well as the resulting increase of the latter, depend upon other, more general causes. The dependence of gold production upon technical inventions and discoveries of new gold mines is only secondary and derived.

Although gold is a generally recognized embodiment of value and, therefore, is generally desired, it is only a commodity. And like every commodity it has a cost of production. But if this be true, then gold production — even in newly discovered mines — can increase significantly only if it becomes more profitable, i.e., if the relation of the value of the gold itself to its cost of production (and this is ultimately the prices of other commodities) becomes more favorable. If this relation is unfavorable, even gold mines the richness of which is by no means yet exhausted may be shut down; if it is favorable, on the other hand, even relatively poor mines will be exploited.

When is the relation of the value of gold to that of other commodities most favorable for gold production? We know that commodity prices reach their lowest level toward the end of a long wave. This means that at this time gold has its highest purchasing power, and gold production becomes most favorable. This can be illustrated by the figures in Table 2.

Gold production, as can be seen from these figures, becomes more profitable as we approach a low point in the price level and a high point in the purchasing power of gold (1895 and the following years).

TABLE 2. — SELECTED STATISTICS OF GOLD MINING IN THE TRANSVAAL, 1890–1913*

Year	Cost of production	Profit
	Per ton of gold ore	
1890.....	42 *sh.* 2 *d.*	7 *sh.* 2 *d.*
1895.....	33 *sh.* 5 *d.*	11 *sh.* 11 *d.*
1899.....	28 *sh.* 0 *d.*	14 *sh.* 3 *d.*
1903.....	24 *sh.* 9 *d.*	14 *sh.* 11 *d.*
1906.....	22 *sh.* 2 *d.*	11 *sh.* 6 *d.*
1913.....	17 *sh.* 11 *d.*	9 *sh.* 10 *d.*

* Cf. W. A. Berridge, "The World's Gold Supply," this REVIEW, II (1920), p. 184.

It is clear, furthermore, that the stimulus to increased gold production necessarily becomes stronger the further a long wave declines. We, therefore, can suppose theoretically that gold production must in general increase most markedly when the wave falls most sharply, and vice versa.

In reality, however, the connection is not as simple as this but becomes more complicated, mainly just because of the effect of the changes in the technique of gold production and the discovery of new mines. It seems to us, indeed, that even improvements in technique and new gold discoveries obey the same fundamental law as does gold production itself, with more or less regularity in timing. Improvements in the technique of gold production and the discovery of new gold mines actually do bring about a lowering in the cost of production of gold; they influence the relation of these costs to the value of gold, and consequently the extent of gold production. But then it is obvious that exactly at the time when the relation of the value of gold to its cost becomes more unfavorable than theretofore, the need for technical improvements in gold mining and for the discovery of new mines necessarily becomes more urgent and thus stimulates research in this field. There is, of course, a time-lag, until this urgent necessity, though already recognized, leads to positive success. In reality, therefore, gold discoveries and technical improvements in gold mining will reach their peak only when the long wave has already passed its peak, i.e., perhaps in the middle of the downswing. The available facts confirm this supposition.[1] In the period after the 1870's, the following gold discoveries were made: 1881 in Alaska, 1884 in the Transvaal, 1887 in West Australia, 1890 in Colorado, 1894 in Mexico, 1896 in the Klondike. The inventions in the field of gold-mining technique, and especially the most important ones of this period (the inventions for the treatment of ore), were also made during the 1880's, as is well known.

Gold discoveries and technical improvements, if they occur, will naturally influence gold production. They can have the effect that the increase in gold production takes place somewhat earlier than at the end of the downswing of the long wave. They also can assist the expansion of gold production, once that limit is reached. This is precisely what happens in reality. Especially after the decline in the 1870's, a persistent, though admittedly slender, increase in gold production begins about the year 1883;[2] whereas, in spite of the disturbing influences of discoveries and inventions, the upswing really begins only after gold has reached its greatest purchasing power; and the increased production is due not only to the newly discovered gold fields but in a considerable degree also to the old ones. This is illustrated by the figures in Table 3.

[1] Berridge, *loc. cit.*, p. 181.

[2] Cf. *Statistical Abstract of the United States*, 1922, pp. 708–09.

TABLE 3. — GOLD PRODUCTION, 1890–1900
(*Unit: thousand ounces*)

	World total	Transvaal	United States	Australia	Russia	Canada	Mexico	India
1890.....	5,749	440	1,589	1,588	1,135	65	737	9
1895.....	9,615	2,017	2,255	2,356	1,388	101	290	230
1900.....	14,838	3,638	3,437	4,461	1,072	1,029	411	412

Source: Berridge, *loc. cit.*, p. 182

From the foregoing one may conclude, it seems to us, that gold production, even though its increase can be a condition for an advance in commodity prices and for a general upswing in economic activity, is yet subordinate to the rhythm of the long waves and consequently cannot be regarded as a causal and random factor that brings about these movements from the outside.

XIII. CONCLUSIONS

The objections to the regular cyclical character of the long waves, therefore, seem to us to be unconvincing.

In view of this circumstance and considering also the positive reasons developed above, we think that, *on the basis of the available data, the existence of long waves of cyclical character is very probable.*

At the same time, we believe ourselves justified in saying that the long waves, if existent at all, are a very important and essential factor in economic development, a factor the effects of which can be found in all the principal fields of social and economic life.

Even granting the existence of long waves, one is, of course, not justified in believing that economic dynamics consists only in fluctuations around a certain level. The course of economic activity represents beyond doubt a process of development, but this development obviously proceeds not only through intermediate waves but also through long ones. The problem of economic development *in toto* cannot be discussed here.

In asserting the existence of long waves and in denying that they arise out of random causes, we are also of the opinion that the long waves arise out of causes which are inherent in the essence of the capitalistic economy. This naturally leads to the question as to the nature of these causes. We are fully aware of the difficulty and great importance of this question; but in the preceding sketch we had no intention of laying the foundations for an appropriate theory of long waves.[1]

[1] I arrived at the hypothesis concerning the existence of long waves in the years 1919–21. Without going into a special analysis, I formulated my general thesis for the first time shortly thereafter in my study, *The World Economy and Economic Fluctuations in the War and Post-War Period* (*Mirovoje 'chozjajstvo i jego konjunktury vo vremja i posle vojny* [Moscow, 1922]). During the winter and spring of 1925, I wrote a special study on "Long Waves in Economic Life" ("Bol'schije cykly konjunktury"), which was published in the volume of the Institute for Business Cycle Research, *Problems of Economic Fluctuations* (*Voprosy konjunktury*, Vol. 1). Only at the beginning of 1926 did I become acquainted with S. de Wolff's article "Prosperitäts- und Depressionsperioden," *Der lebendige Marxismus, Festgabe zum 70. Geburtstage von Karl Kautsky.* De Wolff in many points reaches the same result as I do. The works of J. van Gelderns, which de Wolff cites and which have evidently been published only in Dutch, are unknown to me.

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